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Original Article

A Study of Lipid Profile in Diabetes Mellitus

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Abstract

Background and Objectives: Diabetes mellitus (DM) is a group of metabolic disorders of carbohydrate metabolism in which glucose is underutilized, producing hyperglycemia. Furthermore, it is proposed that underutilization of glucose is associated with changes in lipid profile. Changes in lipid profile are also well related with severity of DM as adjudged by glycated hemoglobin (HbAlc). The study intends to find any correlation among above factors.

Methods: This study involved 40 participants of which 20 were patients admitted with diagnosis of DM, and other 20 were age and sex matched healthy controls who fulfilled inclusion criteria. Blood samples were drawn under aseptic precautions from cases of DM and healthy controls. Necessary investigations were carried out and values were tabulated for cases, and controls separately for statistical evaluation.

Results: In DM patients compared to controls significant increase in following parameters was observed. Fasting blood sugar (FBS), post prandial blood sugar (PPBS), HbAlc, and lipoprotein(a) levels increased significantly ($P < 0.001$). HbAlc/high-density lipoprotein (HDL), HbAlc/low density lipoprotein (LDL), and HbAlc/cholesterol ratios also increased significantly s1). Furthermore, the levels of triacylglycerol (TAG), very LDL (VLDL), and cholesterol/HDL were significantly increased with $P < 0.008$, $P < 0.011$, and $P < 0.003$, respectively. The levels of HDL were significantly reduced in patients with DM compared to controls with $P < 0.001$. There is no significant change observed in cholesterol, LDL, and HbAlc/lipoprotein(a) levels.

Conclusions: There is a statistically significant large effect in FBS, PPBS, HbAlc, TAG, VLDL, HDL, and lipoprotein(a) levels of cases compared with controls, whereas LDL and cholesterol levels are no significant. Increased cholesterol/HDL ratio is well-known risk factors of coronary artery disease. HDL, LDL, cholesterol, and TAG levels were well associated with HbAlc, whereas lipoprotein(a) levels are not associated with HbAlc. Hence, our conclusion is that lipoprotein(a) may not be a dependable risk factor for coronary heart disease.

Key words: Cholesterol, Diabetes mellitus, Glycated hemoglobin, Lipid profile, Lipoprotein(a)

INTRODUCTION

Diabetes mellitus (DM) is the most common metabolic disorder affecting the people worldwide. Even though diabetes has been known since antiquity, only in the last few decades new discoveries have provided great hopes to minimize morbidity and mortality. It is estimated that for one diagnosed diabetes there is undetected diabetes. The diabetic ketoacidosis was major fatal complication of diabetes has virtually come down with advent of insulin. However, the vascular complications have remained same and they have replaced diabetic ketoacidosis as the frequent cause death in diabetes.

Dyslipidemia is commonly seen diabetes. Type 2 DM is one of the most common secondary causes of hyperlipidemia. The relationship between hyperlipidemia and vascular complication of diabetes has long been of interest because both tend to occur with greater frequency in Type 2 DM. Insulin resistance and obesity combine to cause dyslipidemia and hyperglycemia and hyperlipidemia have additive cardiovascular risk. It is recommended that patients with DM should be treated as if they already have coronary artery disease.

Hence identification, critical evaluation, and follow-up of serum lipid profile in Type 2 DM continue to be important.[1-4]

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MATERIALS AND METHODS

Source of Data

The subjects for the study are selected from patients who are admitted to tertiary care hospital.

Method of Collection of Data

From the patients admitted 50 representative cases with H/O Type 2 DM are taken as subjects for the study. Age and sex matches 50 nondiabetic are taken as controls. The diagnosis of diabetes is based on revised criteria according to consensus panel of experts from the National Diabetes Data Group and WHO.

Inclusion Criteria

1. Patients with Type 2 DM of more than 40 years
2. Duration of diabetes more than 4 years.

Exclusion Criteria

Type 2 diabetes patients with concomitant diseases or condition affecting the lipid levels such as hypothyroidism, on lipostatic drugs, and thiazides.

- A detailed history and careful physical examination
- Routine blood and urine examination
- Biochemical analysis for fasting blood sugar (FBS) and post prandial blood sugar (PPBS)
- Fasting serum triglycerides (TGs)
- Total cholesterol (TC)
- High-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C).

Blood Sampling and Preparation of Serum

The blood samples were drawn in the fasting state. The venepunctrue was done in the cubital fossa. Tourniquet was used but was released just before sampling to avoid artificial increase in the concentration of serum lipids. About 10 ml of blood was drown using perfectly dry and sterile syringes, and the blood was transferred to dried glass vials.

Serum was separated within 2 h of collection to prevent artificial changes in concentration of HDL. The blood was centrifuged at 5000 rpm for 10 min. The supernatant clean serum was then pipette out using dry piston pipettes with disposable tips and stored in dry thin walled vials at 4°C. The samples were analyzed the same day. Care was taken to exclude the hamolyzed serum.

Laboratory Procedure

The lipid and lipoprotein assay was done using Dr. Lange LP 700 equipment.

Estimation of TC

Method - CHOD - DAP method.

Principle-enzymatic estimation:

$$\text{Cholesterol ester} \xrightarrow{\text{Ch-esterase}} \text{Free cholesterol} + \text{fatty acids}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\text{Ch-oxidase}} \text{Cholest} - 4 \text{ en} - 3 - \text{on}$$

$$2H_2O_2 + 4 - \text{Aminoantipyriene} + \text{phenol} \xrightarrow{\text{Peroxidase}} H_2O + 4 - P - \text{benziquinone}$$

Estimation of total TGs

Method: GPO-DAP method.

Principle-enzymatic estimation:

$$\text{Triglyceride} + H_2O \xrightarrow{\text{Lipoprotein lipase}} \text{Glycerol} + \text{Fatty acids}$$

$$\text{Glycerol} + \text{ATP} \xrightarrow{\text{Glycerokinase}} \text{Glycerol} - 3 - \text{phosphate} + \text{ADP}$$

$$\text{Glycerol} - 3 - \text{phosphate} + O_2 \xrightarrow{\text{Gly-3-ph oxidase}} \text{Dihydroxy acetone phosphate} + H_2O_2$$

$$H_2P_2 + \text{Amino antipyrine} + \text{ESPAS} \xrightarrow{\text{Peroxidase}} \text{Qunoneimine} + H_2O$$

Estimation of HDL-C

Principle: Enzymatic estimation.

Determination of HDL-C in serum and plasma using polyethane glycol (PEG) modified enzymes, sulfated and cyclodextrin and dextran sulfate. When cholesterol esterase and cholesterol oxidase enzymes are modified by PEG, they show selective catalytic activities toward lipoprotein fractions, with the reactivity increasing in the order LDL < very LDL (VLDL) = Chylomicrons < HDL. In the presence of magnesium ions, sulfated alpha - cyclodextrin reduces the reactivity of cholesterol especially in chylomicrons and VLDL without the need for precipitation of lipoprotein aggregate.

$$\text{HDL} - \text{cholesterol esters} + H_2O \xrightarrow{\text{PEG-cholesterol}} \text{Cholesterol} + \text{RCOOH}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\text{PEG-cholesterol}} \text{Cholestenone} + H_2O_2$$

$2H_2O_2$ + 4-aminophenazone + HSDA* + H+ + H_2O (* - >HSDA - > N [2. Hydroxy–3–sulfopropyl]–3.5 dimethoxyaniline).

Test Principle

Chylomicrons, VLDL, and LDL are precipitated by adding phosphotungstic acid and magnesium ions to the sample. Centrifugation leaves only the HDL in the supernatant. Their cholesterol content is determined enzymatically.

Clinical interpretation: Normal range - 35-55 mg/dl.

It is considered as a risk factor if HDL-C level was <35 mg/dl.

References

1. Burstein, *et al.* (1970) - J. Lipis. Res. 11:583.
2. Lopwa - Virella, *et al.* (1977) Chin. Chern. 23:882.

LDL Cholesterol (LDL-C) Estimation

LDL = TC - HDL - serum TG/5.

VLDL-C

In the absence of chylomicrons, only three forms of lipoproteins are present in the sera - VLDL, LDL, and HDL. Since VLDL is the primary TG carrying form in the fasting state, its concentration can be approximated by dividing the amount of plasma TGs by described by Friedewald in 1972.

Statement of Limitations

Lipoprotein(a) is not evaluated in the study.

Vascular complications are not documented by more appropriate investigations like angiography, Doppler study.

Statistical Analysis

The mean levels of various fractions were correlated with basal reference values for normal individuals. Relevant statistical methods like "Z significant test" (The manual of statistical methods for use in health and nutrition) were used to see the significance of deference in mean values between groups and to know the correlation between inter and intergroup variations.

OBSERVATION RESULT

A total number of 50 patients suffering from Type 2 DM were studied results of various clinical and biochemical parameters and their interrelationship are as follows Table 1 and Graph 1.

Duration of Diabetes

The average duration of diabetes ranged from 4 to 12. The majority of the patients had diabetes of between 5 and 10 years and few had diabetes more than 10 years.

Types of Treatment

24 patients out of 50 were taking only oral hypoglycemic drugs (OHDs), 10 were taking both OHD and insulin. The remaining 10 were taking only insulin.

Degree of Control of Diabetics

The distribution of patients according to the degree of glycemic control based on glycated hemoglobin (HbAlc) level is shown in the Table 2 and Graph 2.

- 18 patients had Grade I severity
- 26 patients had Grade II severity
- 6 patients had Grade III severity.

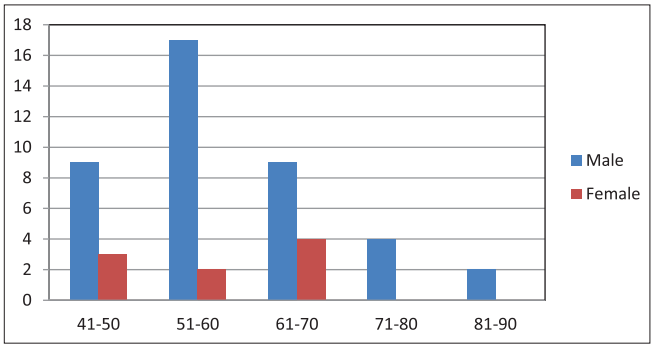
Table 1: Age and sex distribution

Age	Male	Female
41-50	9	3
51-60	17	2
61-70	9	4
71-80	4	0
81-90	2	0

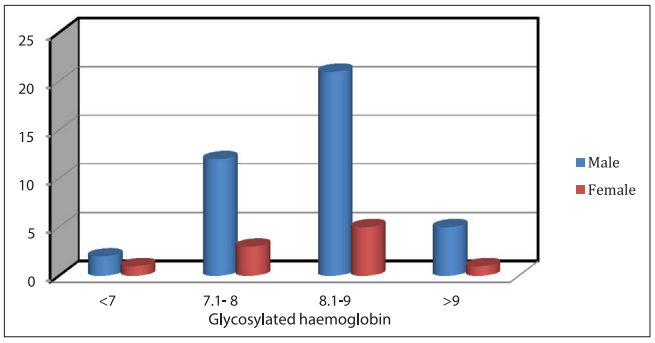
Table 2: Degree of control of diabetics

HbAlc	Male	Female
<7	2	1
7.1-8	12	3
8.1-9	21	5
>9	5	1

HbAlc: Glycated hemoglobin



Graph 1: Age and sex distribution



Graph 2: Degree of control of diabetics

Incidence of Various Complications

The incidence of various complications observed in this study is in the Table 3 and Graph 3. It is observed from the study that retinopathy and peripheral neuropathy were the most common complication 52% and 40%, respectively. Next common was ischemic heart diseases 28%. The list common was cerebrovascular accident. 14% of patients of the study group had no complications.

Comparison of Various Lipid Levels between Diabetes (Study) and Control Group

The Table 4 shows the mean values with standard deviation of various lipid traction of diabetes in comparison to that controls.

If can be seen that mean value all range of lipid fractions except HDL-C are higher in diabetes when compared to controls. However, statistical significance is high for TG, HDL-C, VLDL-C, and low power TC, LDL-C.

Duration of Diabetes and Lipid Profile

Table 5 show the mean value and standard deviation of lipid fraction on different groups diabetes of different duration. Diabetes grouped into four groups duration interval of 3 years in can be observed from the Table 5 that mean values of TG show an increase with increase duration of illness. HDL-C shows trend of decrement in their levels. TC shows an increase initially but later decrease in the trend.

Table 3: Incidence of various complications

Complications	Male	Female	Total
Retinopathy	24	6	30
Neuropathy	16	4	20
Nephropathy	5	4	9
Ischemic heart diseases	9	5	14
Cerebrovascular accident	6	1	7
No complications	6	1	7

Table 4: Comparison of various lipid levels between diabetes (study) and control group

Lipid level	Diabetic	Control	*P* value
TG	183.86±52	183.86±48	<0.001
HDL-C	31.8±6.33	41.20±8.10	<0.001
TC	214.78±43.12	166.88±34.8	<0.001
LDL-C	149.9±11.01	96.9±32	<0.001
VLDL	33±10.1	28.64±8.99	<0.01

Table 5: Duration of diabetes and lipid profile

Duration	TG	TC	HDL
4-6	160.86±46.91	131.93±46.41	32.73±1.03
8-9	191.35±43.80	158.25±47.16	31.60±6.3
10-12	200.08±43.28	216.00±8.4	31.00±0.00
>12	207.5±3.5	183.16±41.91	30.23±0.00
P value	<0.001	<0.001	<0.001

TG: Triglyceride, TC: Total cholesterol, HDL: High-density lipoprotein

SEVERITY OF DIABETES AND SERUM LIPIDS

Table 6 show mean and standard deviation of various serum lipid fraction in relation to severity of diabetes assed by HbAlc levels. It can observe from that there is increase in levels of TGs, TC, LDL-C, and VLDL-C, with increasing severity of diabetes. The difference in values of these lipid fractions were statistically significant. HDL-C levels decreased to significant levels with increasing severity.

DISCUSSION

Type 2 DM has emerged one of the most common causes of dislipidemie vascular complications are believed to be critical for prognosis of DM and there development, in turn, is believed to depend on several factors such as duration, degree of control, and dyslipidemia in diabetes.

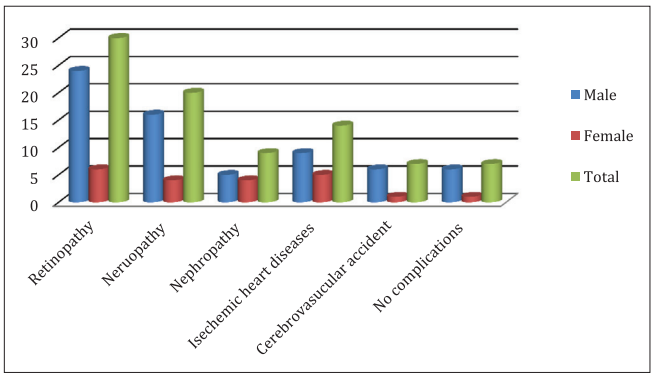
It is been found that Type 2 DM suffer from dyslipidemia intune leading to various vascular complication (All Bright *et al.* 1989).

Age and Sex distribution

Several workers in India (Ajagnakar and Sathi *et al.* 1989; Vaishnava *et al.* 1989; Shankar *et al.*) have reported that in the incidence of diabetes is greater in male then females. In our study, it is observed that 82% were males 18% were females.

Duration of Diabetes

In our study, the average duration Type 2 DM in the study group was 8 years. This is because criteria for inclusion of patients suffering from diabetes more than 4 years.



Graph 3: Incidence of various complications

Table 6: Severity of diabetes and serum lipids

Hb1Ac	TG	TC	LDL-C	HDL-C	VLDC
<7	153.5±9.19	180.66±67.88	118.60±67.88	33.66±6.7	29.00±11.3
7.1-8	171.77±33.76	192.88±33.83	133.22±51.57	32.72±5.67	26.94±10.17
8.1-9	197.04±44.0	241.63±37.83	176.72±52.61	27.6±5.6	37.31±9.09
>9	224.20±23.19	250.05±57.51	186.4±29.21	24.5±4.5	39.6±6.5
P value	<0.01	<0.001	<0.01	<0.001	<0.001

TG: Triglyceride, TC: Total cholesterol, LDL-C: Low-density lipoprotein cholesterol, HDL-C: High-density lipoprotein cholesterol, VLDC: Very low-density lipoprotein

Incidence of Various Complications

In this study, retinopathy was the most common complications followed by neuropathy. Retinopathy was seen in 52% of the study group. According to the American diabetic association, at the 10 and 15 years the diabetic retinopathy was 58% and 18%, respectively. The incidence of peripheral neuropathy seen in this study more are similarly to published reports,

- Mohan *et al.* - 1999 - 34.1%
- Ramachandran *et al.* 2000 - 23.7%.

The above two authors have documented lower incidence of retinopathy.

This could be because in your study most them had nonproliferative or back ground retinopathy and duration of diabetes was slightly higher. In our study, the incidence neuropathy was 40% which coincidence with the study of Niskament *et al.* 1997 - 30%. Other incidence presents in the study coincidence the studies done by Surie *et al.*

Serum Lipid in Diabetes and Control Groups

This study has shown that TG, TC, LDL-C, and VLDL-C, the lipid profile are higher significantly in diabetes than and HDL-C was significantly lower in diabetics than control groups.

According Fredrick *et al.* 1994, Michel *et al.* 1989, in Type 2 DM there is significant elevation of TG, VLDL-C, and decreasing in HDL-C. Our study has shown similar results except for TC, LDL-C which are significantly elevated. The reasons for increasing TC LDL-C are increasing in the incidence of the obesity, sedentary life lack of physical activity, the diet, and risk factors like hypertension.

Severity of Diabetes and Lipid Levels

In our study, severity of diabetes was classified according to the levels of HbAlc a better marker of glucose levels than FBS and PPBS. Here, more than 50% of the patient had more than 8. And also this study shows an significant increasing levels of TG, TC, LDL-C, and VLDL-C and significant decrease in level of HDL-C has the severity of diabetes or HbAlc increased similar results were observed Ahuja *et al.* din 1992; Gossion *et al.* 1986; Pfeifer *et al.* 1987 found similar relationship between HbAlc and various lipid fraction.

Duration of Diabetes and Lipid Levels

This study showed good correlation between duration of diabetes and lipid abnormalities. Similar results were by author Barbara V Howard *et al.* 1984; James S Reitman *et al.* 1987; but some authors, Baker *et al.* (1982), have observed variant observation where there was no correlation between the two.

The study includes Type 2 DM patients who smoke, consume alcohol, and hypertensive. These are risk factors for dyslipidemia. Hence, further study needs to done excluding these risk factors. This study controls were also smokers, alcoholic, and hypertensive. Hence, baseline characters are matched with patients. There is significant increase in LDL-C levels which is not observed in Type 2 DM. Hence, these needs to be further studied to confirm whether Type 2 DM effect LDL-C.[5-8]

SUMMARY

The serum lipid profile of 50 Type 2 DM patients was studied and compared with age and sex matched nondiabetic healthy controls. The serum lipid levels were correlated with various clinical profiles of diabetes such as sex, duration, and severity of diabetes.

In this study group, the average duration of diabetes was 8 years. Of 50 patients, 82% were males and 18% were females. The average duration of diabetes was 8 years. 24 patients were on OHDs, 16 were taking both oral hypoglycemic and insulin, and 10 were on only insulin.

Among the complications, diabetic retinopathy was the most common complication 52%, the second most common was neuropathy 40%. Ischemic heart disease was seen in 28%, nephropathy was seen in 18%, and cerebrovascular accident in 14%.

The mean values of the entire lipid fraction TG, TC, LDL-C, and VLDL-C, were statistically significantly higher in diabetes than healthy controls. There was correlation between lipid levels and duration of diabetes for all lipid

fractions which were significant. All lipid fractions showed a progressive increase severity of diabetes. The difference was statistically significant.

Degree of control diabetes was inadequate as more than 50% had high HbAlc. This probably the main reason for significant dyslipidemia and as well as complication.

CONCLUSION

From this study, it was evident that DM has a real impact on lipid metabolism. This was substantiated by the fact that all the lipid fractions were elevated in diabetes when compared to healthy controls. Hence, hyperlipidemia is quite common in diabetes and hypertriglyceridemia is the most common abnormality.

The age and sex of the patients did not have much influence on serum lipids. The duration of diabetes and the severity of diabetes had marked influence on lipid levels. Hence, good control of diabetes would help to check the alterations in lipid levels.

Diabetic patients with complications tend to have higher levels of lipid fractions (TGs, cholesterol, and LDL-C) and lower levels of HDL-C. This suggests that there appears to be some relation between the genesis of various vascular complications (micro vascular and macro vascular), and the presence of lipid abnormality. It is difficult to point out a particular factor as the cause as multiple mutually interacting factors determine the presence or development of these complications. As good control of diabetes is shown to keep the lipid levels in near normal range, it appears important to aim at critical control of DM to prevent or at least postpone the onset of various complications.

REFERENCES

1. Chaturvedi N, Fuller JH, Taskinen MR; EURODIAB PCS Group. Differing associations of lipid and lipoprotein disturbances with the macrovascular and micro vascular complications of Type 2 diabetes. Diabetes Care 2001;24:2071-7.
2. Mazzone T. Current concepts and controversies in the pathogenesis, prevention, and treatment of the macrovascular complications of diabetes. J Lab Clin Med 2000;135:437-43.
3. Ginsberg HN, Goldberg LL. Disorders of lipoprotein metabolism. In: Fauci AS, Braunwald E, Isselbacher KJ, Wilson JD, Martin JB, Kasper DL, *et al*., editors. Harrison's Principles of Internal Medicine. Vo1. 2. Ch. 344. New York: McGraw Hill Medical Publishing Division; 2001. p. 2246.
4. Harvey JN. Diabetic nephropathy. BMJ 2002;325:59-60.
5. The Diabetes Atorvastatin Lipid Intervention (DALI) Study Group. The effect of aggressive versus standard lipid lowering by atorvastatin on diabetic dyslipidemia: The DALI study: A double-blind, randomized, placebo-controlled trial in patients with Type 2 diabetes and diabetic dyslipidemia. Diabetes Care 2001;24:1335-41.
6. Femske TK. Lipid – Lowering update 2001. Aggressive new goals. Can Fam Physician 2001;47:303-9.
7. Andersson B. Hormone replacement therapy in postmenopausal women with diabetes mellitus: A risk benefit assessment. Drugs Aging 2000;17:399-410.
8. American Diabetes Association. Evidence – Based nutrition principles and recommendations for the treatment and prevention of diabetes related complications. Diabetes Care 2002;25 Suppl 1:S50-60.

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